



The JWST North Ecliptic Pole Survey Field for Time-domain Studies



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ABSTRACT

The JWST North Ecliptic Pole (NEP) Survey field is located within JWST's northern Continuous Viewing Zone (CVZ), will span $\sim 14'$ in diameter ($\sim 10'$ with NIRISS coverage) and will be roughly circular in shape (initially sampled during Cycle 1 at 4 distinct orientations with JWST/NIRCam's $4.4' \times 2.2'$ FoV – the JWST “windmill”) and will have NIRISS slitless grism spectroscopy taken in parallel, overlapping an alternate NIRCam orientation. This is the *only* region in the sky where JWST can observe a clean extragalactic deep survey field (free of bright foreground stars and with low Galactic foreground extinction A_V) at *arbitrary cadence* or at *arbitrary orientation*. This will crucially enable a wide range of new and exciting time-domain science, including high redshift transient searches and monitoring (e.g., SNe), variability studies from Active Galactic Nuclei to brown dwarf atmospheres, as well as proper motions of extreme scattered Kuiper Belt and Oort Cloud Objects, and of nearby Galactic brown dwarfs, low-mass stars, and ultracool white dwarfs. We therefore welcome and encourage follow-up through GO programs of the initial GTO observations to realize its potential as a JWST time-domain *community field*. The JWST NEP Survey field was selected from an analysis of WISE 3.4+4.6 μm , 2MASS JHKs, and SDSS *ugriz* source counts and of Galactic foreground extinction, and is one of very few such $\sim 10'$ fields that are devoid of sources brighter than $m_{AB} = 16$ mag. We have secured deep ($m_{AB} \sim 26$ mag) wide-field ($\sim 23' \times 25'$) *Ugriz* images of this field and its surroundings with the LBCs on the 2×8.4 m Large Binocular Telescope. We also expect that deep ground-based *JHK* images, deep 3 and 10 GHz VLA radio observations (pending), and possibly *HST* ACS/WFC and WFC3/UVIS ultraviolet-visible images will all be available before JWST launches in Oct 2018.

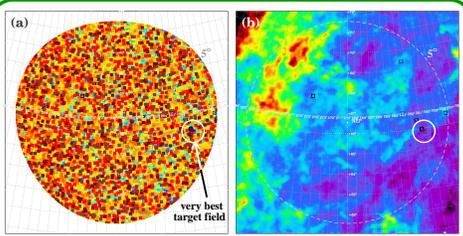


Fig. 1.— Selection of the JWST NEP Survey Field. (a) We identified promising target regions in a $5'$ radius map centered on the NEP of $\sim 4 \mu\text{m}$ source count penalties. *Very few $10' \times 10'$ regions exist that are free of sources brighter than $m_{AB} = 16$ mag.* (b) Map of $E(B-V)$ values (from Schlafly & Finkbeiner 2011) in the $11' \times 11'$ area around the NEP. The very best $10' \times 10'$ region is indicated by a small magenta square within the white circle. The dashed circle with a radius of $5'$ indicates the JWST CVZ. In the best target field near $(\alpha, \delta) = (261^\circ, +66^\circ)$, Galactic foreground extinction is very moderate at $E(B-V) \leq 0.028$ ($A_V \leq 0.015$ mag), proving that the paucity of $4 \mu\text{m}$ -bright sources is not due to foreground dust.

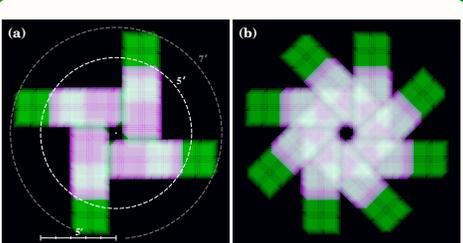
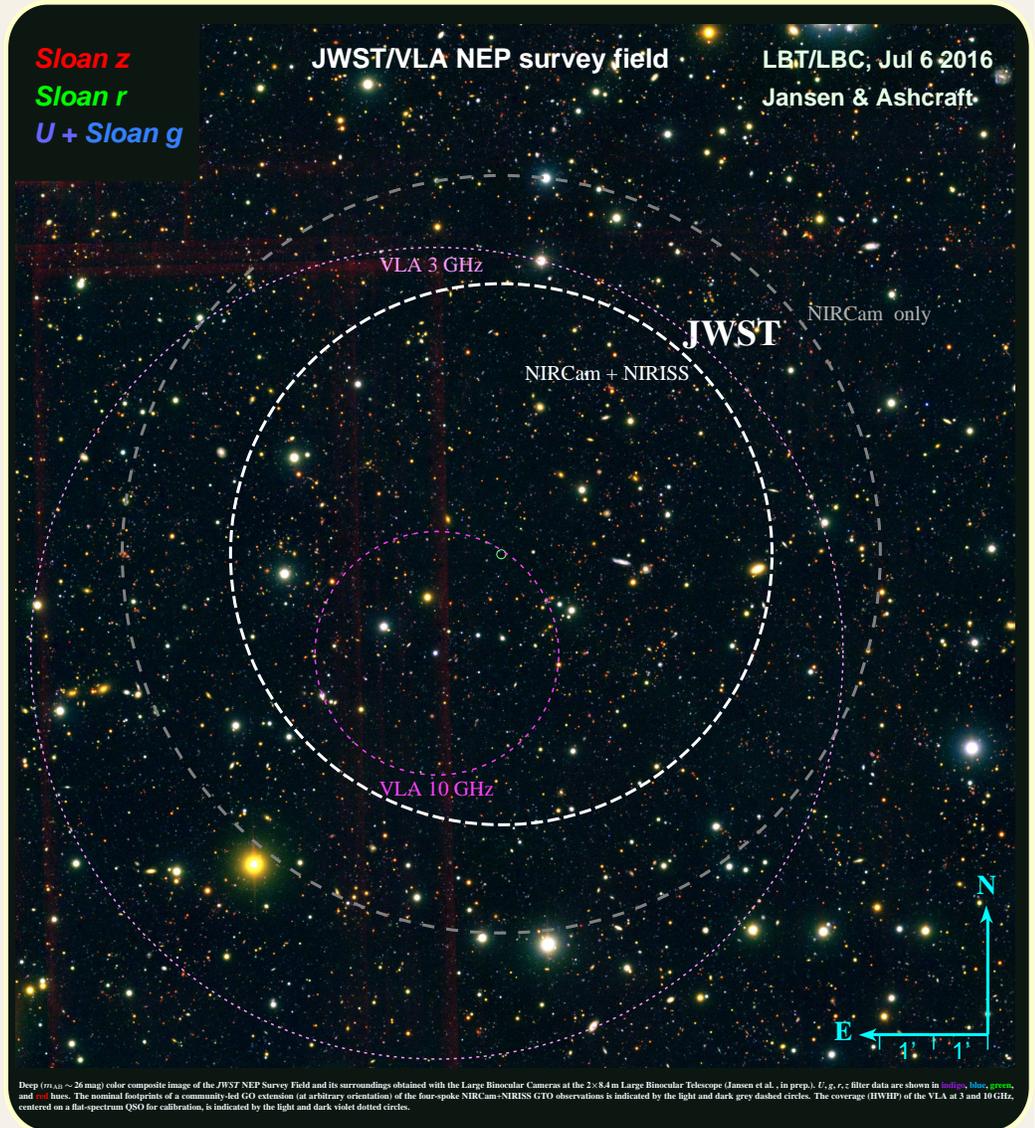


Fig. 2.— $15' \times 15'$ exposure maps of (a) the core GTO JWST NEP survey, with NIRSIS slitless grism observations overlaid (purple-pink lines on the exposure map of the primary NIRCam observations in green, and of (b) an anticipated community-driven GO extension of the JWST NEP survey. The ΔPA with respect to the core footprint may be (but does not need to be) 45° , and the field may be revisited at any given orientation or cadence. The circles with $5'$ and $7'$ radius in panel (a) are also shown in the large LBT/LBC *Ugriz* color composite image at right. This NEP CVZ survey field is the *only* relatively empty region in the sky where JWST can observe at *arbitrary cadence* and *arbitrary orientation*, and will be the best field for time-domain studies with JWST.



Deep ($m_{AB} \sim 26$ mag) color composite image of the JWST NEP Survey Field and its surroundings obtained with the Large Binocular Camera at the 2×8.4 m Large Binocular Telescope (Jansen et al., in prep.). *U, g, r, z*: filter data are shown in *indigo, blue, green, and red* hues. The nominal footprints of a community-led GO extension (at arbitrary orientation) of the four-spoke NIRCam+NIRISS GTO observations is indicated by the light and dark grey dashed circles. The coverage (HWHP) of the VLA at 3 and 10 GHz, centered on a flat-spectrum QSO for calibration, is indicated by the light and dark violet dotted circles.